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Understanding Service Design Approaches in Technology Start-ups

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Master Thesis

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Abstract

Great innovations are often the final outcome of the creation of start-ups. Such new companies represent an important variant of the innovation process, one that is designed around rapid growth. In the last fifty years, the majority of new ventures are technology-based companies (Freeman and Engel, 2007). In their early-stages, technology start-ups tend to be product-oriented and often developer-led (Coleman and O'Connor, 2008; Paternoster *et al.*, 2016). However, most startups lack a process for discovering their markets, locating their customers, developing the market, verifying the business model, and growing their business (Blank, 2003; Sauvola *et al.*, 2015). Additionally, at the present, having a radical solution or a unique business model is no longer enough to succeed. Customers, partners, and investors not only see technology as a differentiator but also the overall experience underlying it.

Service Design (SD) can leverage technology innovation in order to develop valuable solutions as it focuses on a deep and empathic understanding of customer problems and needs, with the ultimate goal of providing a holistic and well-planned customer experience (Stickdorn and Schneider, 2010). However, research is needed on how service design can be applied in the context of technology start-up's processes. To this end, the overarching goal of this research has been to explore and understand the processes performed by technology start-ups when developing unique products and services.

By identifying the current processes on technology start-ups, the results of this research contribute to the lack of understanding on the matter. Through a multiple case study, empirical findings show that start-ups use both innovation and service design processes which most of them are identified in the literature and some emerged from the data analysis. The interaction between the processes is very dynamic and very much depending on the steps and decisions made by the founders. Empirical findings also show that technology startups are adopting mainly the first stages of SD related to the exploration of ideas and the understanding of the customer point of view. A good solution would be to look at innovation processes and enhance them with service design practices to create solutions that fulfill and exceed customers' expectations. Since companies such as these are highly different and develop innovative solutions in a distinctive way, there is not a single and correct way to implement service design processes.

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Table of Contents

List of Tables

List of Figures

List of abbreviations

B2B – Business to business

B2C – Business to consumer

CEO – Chief Executive Officer

MVP – Minimum Viable Product

NPD – New Product Development

R&D – Research & Development

SD – Service Design

1 Introduction

The first chapter introduces the main topic of this master thesis and briefly states the motivation for the development of the project. Additionally, this chapter outlines the project report structure.

1.1 Motivation

Innovation

The need to innovate seems to be an intrinsic characteristic of human beings. New and better ways of doing things are continually being developed (Fagerberg and Mowery, 2009). Nowadays, the ability to change is seen as a core competence of any corporation that wants to ensure its survival (Trott, 2005). Innovation can even take the form of competitive advantage for businesses as they can continuously provide unique offerings. Being able to make something no one else can, or to do so in ways which are better than anyone else is a powerful source of advantage. Similarly, being able to offer a better service – faster, cheaper, higher quality – has long been seen as a source of competitive edge (Tidd, Bessant and Pavitt, 2005). Moreover, innovation is now considered as important for businesses as it is for economies. Continuous innovation is linked to jobs, profit, and standard of living. Therefore, both organizations and economies must innovate and promote innovation (Baregheh, Rowley and Sambrook, 2009).

Based on a content analysis of previous definitions, Baregheh, Rowley and Sambrook (2009, p.12) arrived at an integrative definition of what innovation is:

> "Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace."

Innovation is all about the creation of new markets and offer new ways of serving established ones. Nevertheless, innovation is not confined to products but can also be found in services. Although innovation is increasingly seen as a powerful way of securing competitive advantage, it does not guarantee success. Innovation is by its nature a risky business because of the uncertainty related to technical, market, social, political and other factors. Faced with a risky and uncertain process, many organizations decide not to innovate, even though the possible rewards are attractive. However, that approach is rarely an option, especially in turbulent and rapidly changing sectors of the economy. In essence, unless organizations are prepared to renew their products and processes on a continuing basis, their survival chances are seriously threatened (Trott, 2005; Tidd, Bessant and Pavitt, 2005).

The emergence of innovation

The innovation process can occur in one of two ways: the Corporate Model which refers to innovations that rise in existing corporations and the Entrepreneurship Model which applies to companies newly started by entrepreneurs known as start-ups or ventures. This research focuses on a distinct form of entrepreneurial venture around technology. Such new companies

represent an important variant of the innovation process, one that is designed around rapid growth (Freeman and Engel, 2007).

Shepherd and Katz (2003) suggest that venture ideas are internally generated, that is, in individuals' minds) based on perceptions of external conditions. Over time, they can change and become more and more elaborate. Therefore, the entrepreneurial discovery process starts with the conception of a venture idea, following discovery and exploitation.

Discovery refers to the initial conception and further development of a venture idea to be proved. Exploitation thus has to do with the attempted realization of ideas. Discovery and exploitation are seen as overlapping steps. Although the definition of concepts started with discovery, the process itself does not necessarily follow that way. Empirical research suggests that venture creation processes can follow almost any sequence (Shepherd and Katz, 2003).

Technology Start-ups

In the last fifty years, the majority of new ventures are technology-based companies (Freeman and Engel, 2007). Technology often plays a key role in enabling radical offerings. Technology start-ups are newly established companies commonly conceived to develop innovative technology-based products and services. In their early-stages, technology start-ups tend to be product-oriented and often developer-led. They concentrate their efforts on developing and implementing products and services (Coleman and O'Connor, 2008; Paternoster *et al.*, 2016). In fact, Sutton (2000) claims that the primary resources of a company are allocated to "getting the product out, promoting the product, and building up strategic alliances." Similarly, research conducted by (Paternoster *et al.* (2016) shows that "…start-ups' most urgent priority is releasing the product as quickly as possible to verify the product/market fit, and to adjust the business and product trajectory according to early feedback…". Given the continuous changes in the business technology and its highly competitive market, it is crucial that start-ups develop innovative solutions fast and release them quickly to offer timely valuable solutions that meet customer's needs. Otherwise, competitors may take that chance (Hokkanen and Leppänen, 2015; Sauvola *et al.*, 2015). Moreover, technology-oriented innovation creates products and services that would otherwise not exist thus producing major success stories (Möller, Rajala and Westerlund, 2008; Walsh, Kirchhoff and Newbert, 2002).

Challenges

When entrepreneurs take the technology push approach, they need to accept the higher business risk of not meeting the clients' expectations. Cutting-edge technologies may give start-ups an initial competitive advantage, but that may not last long. With all the rushing, start-ups may base their solutions more on intuition rather than customer feedback. That can lead to a gap between the products/services start-ups have to offer and the customer's needs and expectations. Consequently, start-ups may have to deal with a significant amount of expenses taking corrective actions and improve their offerings. Also, they may face resistance from potential users to adopt their inventions as customers will not appreciate the new functionalities that are offered, or their lack of competences restricts them from enjoying the targeted benefits from disruptive technologies (Möller, Rajala and Westerlund, 2008; Walsh, Kirchhoff and Newbert, 2002).

In contrast with most well-establish companies where customers, problems, needs and necessary product features are clear, in a start-up context both the problem and the solution aren't well understood. Therefore, it is even more critical for start-ups to focus not only on the technology itself but also on customers' needs and service requirements (Blank and Dorf, 2012; Bosch *et al.*, 2013). Steve Blank, researcher, and practitioner of the startup community states that before selling and marketing, the company must show substantial evidence that a market could exist and that customers are willing to pay for their offerings. Activities such as testing, learning, and discovery are the core of unique start-ups. However, most startups lack a process for discovering their markets, locating their customers, developing the market, verifying the business model, and growing their business (Blank, 2003; Sauvola *et al.*, 2015). Lewrick (2009) characterized companies by its business strategy, innovation success and productivity and stated that a common low performing company lacks in customer orientation. Many companies that focus on a strong product development process end up disregarding customer needs. Additionally, a competitor orientation leads to imitation, that is, offering similar products or services thus lacking in breakthrough innovations to sustain business success. Another characteristic of low performing companies is the lack of continuous learning and planning to expand their product and service offering.

At the present, having a radical solution or a unique business model is no longer enough to succeed. Customers, partners, and investors not only see technology as a differentiator but also the overall experience underlying it. Inventions turn into useful innovations only when integrated into broader technological and social systems needed to bring an invention to the market. Nonetheless, there is the difficulty on assessing the potential services that may be embodied with product technologies. Services increasingly form a greater proportion of our consumption and provide access to complex product technologies. Many complex product technologies have the chance to greatly improve the quality of life only when embedded in the proper service framework (Kimbell and Seidel, 2008).

Service Design

To fulfill and exceed the high expectations of customers, technology companies, particularly, technology start-ups, must accurately translate customers' needs and wants into products and services that enhance people's lives. Service Design (SD) is seen as an interdisciplinary, creative and practical approach which is becoming widely used to improve existing services and create new ones (Brown, 2008; Evenson and Dubberly, 2010). This approach focuses on a deep and empathic understanding of customer problems and needs, with the ultimate goal of providing a holistic and well-planned customer experience (Stickdorn and Schneider, 2010). Given that, SD has great potential to leverage technology development to create new value propositions and valuable solutions by focusing on the broad and all-encompassing understanding of customers. However, research is needed on how service design can be applied in the context of technology start-up's processes. To this end, the overarching goal of this research has been to explore and understand the processes performed by technology start-ups to understand how service design can be incorporated into the overall process.

1.2 Report outline

The master thesis is structured as follows:

- Section 2 presents the theoretical framework by which this research will be framed with the purpose of enhancing the understanding of the matter in question. This chapter reviews relevant research on innovation, technology, and service design processes.
- Section 3 describes the Research Methodology, that is, the process of how the research was performed, including the research method chosen and how the data was collected and analyzed.
- Section 4 presents the case study findings in the form of within and cross-case analysis.
- Section 5 states the discussion of the empirical findings of the analysis chapter in contrast to the theoretical framework.
- Section 6 presents the main conclusions of the research and suggests topics for further investigation.

2 Literature Review

This chapter describes the research theoretical foundation covering the relevant literature on the processes of service design and of developing innovations. Additionally, it defines the research question and objectives.

2.1 Innovation Models and Processes

Traditionally, the innovation process has been referred to the sequence of stages which starts with idea generation and ends with the commercialization of the solution (Baregheh, Rowley, and Sambrook, 2009; Freeman and Engel, 2007). In the past decades, the literature has identified and described different forms of innovation models to better understand how innovation activities are performed. Most of the different innovation models refer to Rothwell (1994) standard classification, evolving from linear to complex and integrated models.

Rothwell (1994) identified five generations of innovation models. The first generation of the innovation process is defined as a sequential and linear process and viewed as a series of stages triggered by the output of the previous step. The starting point of the process is scientific research and culminates with the commercialization of the technological solution. The science-push or technology-push perspective assumes that research and development (R&D) is the primary trigger for innovations that will be adopted by the market. The stages of the process are identified as basic science, design and engineering, manufacturing, marketing, and sales. In contrast with the first generation, the second generation takes a very different approach from the scientific research. The model is identified as customer-centered, and market needs are the source of the ideas. The stages of the process are identified as market need, development, manufacturing, and sales (Al-Hakim *et al.*, 2016; Forrest, 1991; Rothwell, 1994). As the first and second generations of innovation models represent two extremes, they were later integrated resulting in the third generation of models (Figure 1). This model represents both the knowledge gained from advances in scientific research and the market needs as factors that lead to innovations. The innovation process is described as a sequential process, but it also involves several links between various functions (Al-Hakim *et al.*, 2016; Forrest, 1991; Rothwell, 1994).

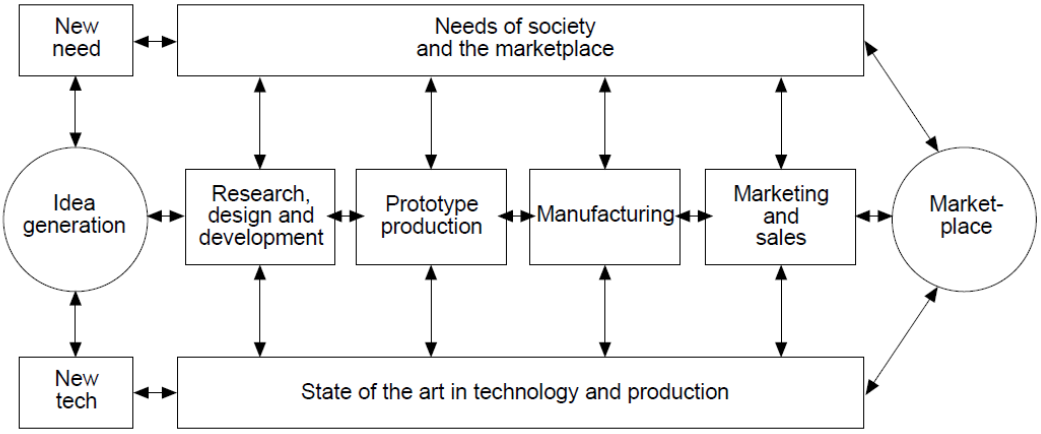

Figure 1 – The "Coupling" Model of Innovation (Third Generation) from Rothwell (1994)

Although these simpler models can support the understanding of the innovation process, they do not consider its complexity and uncertainty. While recognizing research and market needs as inputs is essential, these models fail to include other aspects essential in the innovation process such as feedback loops, time and customer input (Al-Hakim *et al.*, 2016) (Forrest, 1991). The fourth generation of the innovation process remains with the idea of research and market needs as impulses for innovation but also includes the close integration with suppliers. The fifth generation is an enlarged version of the fourth generation as it evades organizational boundaries towards external networks. Although these later generation models are more complex, they still adopt most of the basic elements from the previous ones (Al-Hakim et al., 2016).

Innovation models have been subject to criticism. For example, Forrest (1991) states that some elements are overlooked in the majority of the models such as a pre-innovation stage where idea generation and screening takes place; a post-innovation stage; the time and environmental variables; the continuous evaluation of the technological innovation; the formation of strategic alliances and so on. Besides, the traditional models have been focused on large corporations with established R&D departments and time-consuming projects. Therefore, these models aren't well suited for other types of projects with a high degree of uncertainty and complexity (Salerno *et al.*, 2015).

New products have been considered as the output of innovation thus the new product development (NPD) process is viewed as a subprocess of the overall innovation process (Koen et al., 1996; Trott, 2005). The linear and sequential process shown in Figure 2 is the most common and primary process presented as the NPD model (Cicea et al., 2015). NDP model begins with the development of new product strategies where missions and objectives of the organizations are reviewed. Next, product ideas are searched for, and the environment is scanned in search of new opportunities. Then, the ideas generated are investigated and evaluated, and the most promising ones are analyzed regarding business viability. The ones that prove to be viable are developed and then tested. After that, products enter the market and get feedback from customers (Fortenberry, 2013).

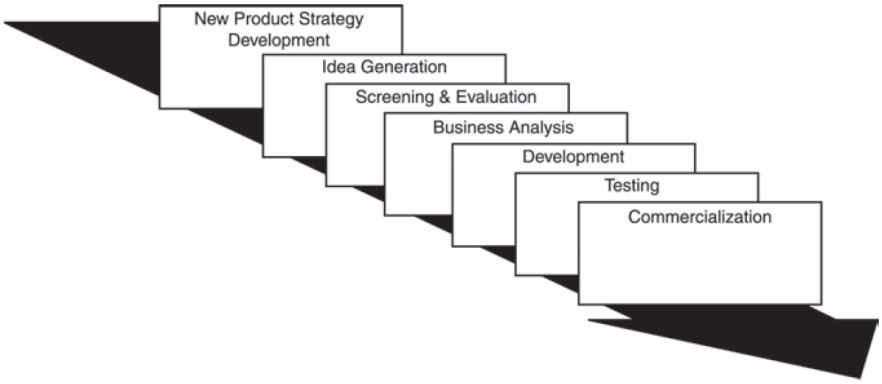

Figure 2 – NPD Model from Fortenberry (2013)

Most of the research on the NPD model focuses on the development of incremental technological innovations. However, the innovation process regarding radical innovations might be quite different. Among other reasons, more effort is required to identify product opportunities, establish the suitability of new technologies and determine their success in the

marketplace. Although NPD activities are essential for the success of most new products, the development process of radical solutions needs further understanding (Veryzer, 1998).

As stated before, there has been a proliferation of innovation models. Nonetheless, it seems that there is a consensus regarding the major phases of the innovation process despite the different classifications. For instance, in an early study Utterback (1974) identified three major phases of the innovation process: idea generation which involves the gathering and synthesis of information from several sources regarding the market, needs or problems; problem-solving or developing which includes setting specific technical goals and designing alternative solutions; implementation and diffusion which consists of the manufacturing-engineering and other activities required to bring an original solution or invention to life and its introduction in the environment. Similarly, King (cited in Saren, 1984) hypothesizes three main stages of the innovation process, namely, planning, development and evaluation and suggests specific actions within each stage. More recently, Garud, Tuertscher and Van De Ven (2013) conducted a review of the literature on innovation processes considering the main innovation processes as *invention* (the emergence of an idea), *development* (the elaboration of the idea), and *implementation* (the adoption of the innovation). Feedback drives the overall process as different individuals interact with the innovation. From a synthesis of the innovation process models found in the literature, D du Preez and Louw (2008) suggests different steps before development and implementation. The authors break down the *invention* stage into idea generation and identification; concept development and concept evaluation and selection. Similarly, Tidd, Bessant, and Pavitt (2005) suggest that modern innovation processes involve searching or scanning the internal and external environment for threats and opportunities to decide according to the strategy of the company how can best respond to the environment. The authors also mention another activity or process after implementation, which is learning. Companies may take this phase to learn from the process and feedback of the stakeholders to improve the developed solutions.

Be that as it may, innovation processes differ according to many factors, including the type of innovation, the field of knowledge, size of the firm, its strategies and its prior experience with innovation (Fagerberg and Mowery, 2009). Additionally, innovation processes may not necessarily follow a linear sequence from invention to implementation, and will involve multiple levels various sub-processes of the framework which can lead to zig-zagging dynamics as the processes unfold. Moreover, whereas one could imagine and initiate the innovation process based on a certain framework, the processes seldom unfold as the ones envisioned when roadblocks or new opportunities are encountered (Garud, Tuertscher and Van De Ven, 2013).

To sum up, the innovation process has been referred as a sequence of stages which starts with idea generation and ends with commercialization (Baregheh, Rowley, and Sambrook, 2009; Freeman and Engel, 2007). Over the last two decades, the process of innovation has been evolving. The literature has identified and described different forms of innovation models to understand better how innovation activities are performed. Nonetheless, these models are not well suited for other types of projects with a high degree of uncertainty and complexity, which are the case of technology start-ups' innovative solutions. Although NPD activities are essential for the development of incremental technological innovations, the development of radical solutions needs further understanding. There are some common activities performed

by companies when it comes to the process of innovation although it seems that each one of them will focus on what appears more appropriate to their unique business since there is not "one size fits all" model.

2.2 Technology Development and Innovation

Having covered the innovation models, it is also important to address the specific processes and activities of technology development. According to the study conducted by Liao and Welsch (2008), entrepreneurial activities focus on scanning the external environment by continuously assessing technological advantage and identifying market opportunities; building and establishing legitimacy; acquiring and combining resources to survive and seeking venture capital investment. However, technology-based entrepreneurs limit marketing efforts at the gestation stage compared with other activities. The authors argue that since most technology-based entrepreneurs tend to have a technical and engineering background, they tend to adopt a market pull strategy, where marketing activities may take place later on the venture creation. The prevailing mindset is that technology innovations "sell themselves."

Although there are several traditional and widespread technology development models such as waterfall and spiral models (Unger and Eppinger, 2011), interviews conducted by Bosch *et al.* (2013) settles that "it is very difficult to know how to work straightforwardly in early-stage start-ups…". This may have to do with the start-ups' unique nature and challenging environment they work on: "…processes in start-ups are evolutionary in nature, and the product is obtained by iterating and updating an early prototype driven by customer feedback" (Paternoster *et al.*, 2014).

Be that as it may, in recent years, an innovation methodology with high-technology start-ups in mind was proposed by the entrepreneur Eric Ries, known as Lean Startup, which is based on a hypothesis-driven approach. The methodology brings together principles of lean practices, as well as customer development and agile practices (Blank and Dorf, 2012).

The hypothesis-driven entrepreneurship process (Figure 3) starts with the entrepreneur's vision of a problem and its potential solution. With that in mind, business model hypotheses are formulated and then tested using a series of minimum viable products (MVPs). Based on the results of the tests, entrepreneurs must decide whether to persevere with the initial business model, to pivot by changing and maintaining some elements of the business model, or merely to quit. The build-measure-learn loop is done until all the key business model hypotheses are validated through MVP tests. When all the business hypotheses are validated, the start-up has achieved a product-market fit and can start scaling (Eisenmann, Ries and Dillard, 2011).

A fundamental principle of Lean Start-up is to test potential market solutions with potential consumers as soon as possible. The idea behind the principle is to create the simplest marketable product (MVP) to get a fast experimentation and learning loop that comes from testing the product with users to mitigate future risks of development. It is a high risk to develop a full product before testing the concept in the market, especially under extreme uncertainties from which start-ups emerge. Having that settle, testing hypotheses can reveal if the original idea is valid and can be further developed or is not valid in which case assumptions must be revised or even changed (Moogk, 2012).

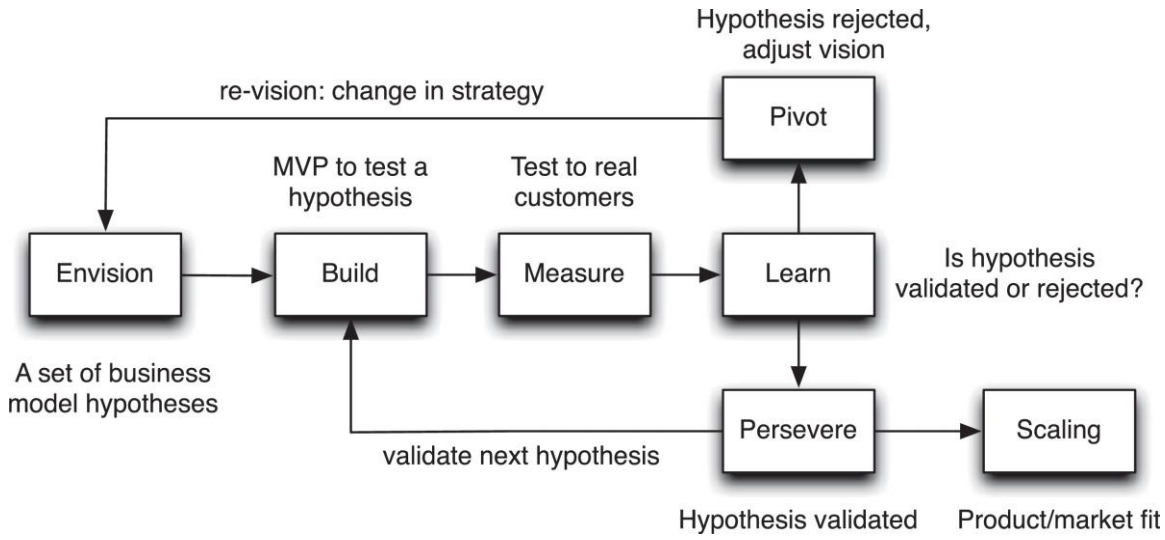

Figure 3 – Hypothesis-Driven Entrepreneurship Process from Edison *et al.* (2018)

Lean Startup was developed with the goal of fostering innovations. In a lean startup process, the project starts with the vision of the founders, so a concrete business idea is already in place from the beginning and it goes straightforward to prototyping and testing. Also, lean startup does not describe specifically practices and frameworks on how customer input could be collected and alaysed. This can lead to a poor identification and understanding of the targeted customers and their needs and problems thus making the process of achieving problem-solution fit even harder (Müller and Thoring, 2012).

2.3 Service Design and Innovation

According to Michel, Brown and Gallan (2008), innovation consists of finding new ways of co-solving customer problems and needs whether customers recognize them or not. Additionally, the author argues that all innovations, be they service processes or tangible products, should be viewed as a service-logic innovation. He explains that customers do not seek products; they seek satisfaction and products thus represent vehicles for service by enabling customers to effectively pursue their individualized satisfaction (Michel, Brown and Gallan, 2008). Having that said, it is suggested that service innovation refers to the creation of new and/or improved service offerings, service processes, and service business models (Ostrom et al., 2010).

Nowadays, there is a plethora of solutions in the market thus customers are getting more and more demanding. To put it another way, as our basic needs are met, we increasingly look forward to new and sophisticated experiences that are emotionally satisfying and meaningful. Hence, innovations can be powered by a thorough understanding of what people want and need in their lives and what they like or dislike. Therefore, it is required a human-centered, creative, iterative, and practical approach to finding the best ideas and ultimate solutions (Brown, 2008; Evenson and Dubberly, 2010).

The Service Design Approach

Service Design, which is seen as an interdisciplinary, creative and holistic approach, is becoming widely used to improve existing services and creating new ones. This approach

assumes the customer or user as the starting point or lens into a specific service (Holmlid and Evenson, 2008). Therefore, SD focuses on a deep and empathic understanding of customer problems and needs, with the ultimate goal of providing a holistic and well-planned customer experience (Stickdorn and Schneider, 2010). It involves the orchestration of clues, places, processes, and interactions that together create holistic service experiences (Ostrom et al., 2010). Service design focuses on services and related processes, experiences and interactions, adopting service-specific design tools (e.g. the system map and the user journey map) to describe them (Foglieni, Villari and Maffei, 2018). Given that, service design has a fundamental importance in service innovation because it brings innovative ideas to life (Ostrom et al., 2010; Patrício, Gustafsson and Fisk, 2018). Recent research has been dedicated to characterizing services, defining service design concepts, supporting the design of the services and describing the service design process (Kimbell, 2011; Steen, Manschot and De Koning, 2011; Stickdorn and Schneider, 2010). According to Mager and Sung (2011, p.1):

> "Service design aims at designing services that are useful, usable and desirable from the user perspective, and efficient, effective and different from the provider perspective. It is a strategic approach that helps providers to develop a clear strategic positioning for their service offerings. Services are systems that involve many different influential factors, so service design takes a holistic approach in order to get an understanding of the system and the different actors within the system."

The Service Design Process

The service design process has been widely represented by the academic and the professional fields, commonly depicted from three to more steps. Ultimately, they share the same notion of a first step focused on exploration and research up to a final step of delivery of the solution to be implemented (Foglieni, Villari and Maffei, 2018). However, it is recognized that the identified steps of the process "are a very basic approach to structure such a complex design process" (Stickdorn and Schneider, 2010, p. 117).

The complex process is viewed as four different stages, namely: exploration, ideation, reflection, and implementation. In essence, the exploration phase is dedicated to a depth study of the stakeholders and their experience, behaviour, and context, that is, anything that can influence their lives; ideation phase, as the name implies, is when new service concepts are generated and developed, and then there are prototyped and tested with potential customers in reflection phase. Lastly, the implementation phase refers to the activities of planning, implementing and reviewing (Brown, 2008; Patrício and Fisk, 2013; Stickdorn and Schneider, 2010).

The first stage of SD is exploration, which can be briefly defined as understanding the customer experience. The exploration stage is crucial for human-centered service design because it provides an in-depth and clear understanding of the contexts, activities, problems and needs of the customers and all the stakeholders. The aim of this methodology is not trying to find the solution immediately, rather it is identifying the real problem and ascertaining how potential customers perceive the situation and the true motivations behind customer behaviour (Brown 2008; Patrício and Fisk, 2013; Stickdorn *et al.*, 2011). In essence, "understanding people, contexts, and relationships helps define the overall framework that is necessary to trigger the following concept generation phase" (Foglieni, Villari and Maffei, 2018).

In fact, the customer involvement on the exploration phase aims to support service designers to improve the creative process of generating innovative service ideas and to develop better service definitions, by proactive understand what people think and do when facing a real need or a real problem (Steen, Manschot and De Koning, 2011). Furthermore, when the service design is co-created, the gap between the designed service and the customers' needs becomes smaller, which can contribute to a better service experience, to meet or exceed customers' expectations and enhance the perceived value from the customer's point of view. A good way of turning customer inputs into innovation is to focus on the outcomes desired by customers want in using a new product or service, that is, what customers are trying to achieve (Ulwick, 2002).

In the SD process, ideation is the stage that follows exploration. Having a deep and clear understanding of the customer experience, it's time to generate ideas and develop new service concepts based on the insights obtained on the exploration phase. This stage is not about avoiding mistakes, but rather to explore as many possible (Brown 2008; Patrício and Fisk, 2013; Stickdorn *et al.*, 2011). Ideation aims to generate a great number of ideas at a very high concept level. After that, a selection process takes place in order to identify the most promising concepts that will be developed. Developing a service concept means bringing it at a deeper level of detail. It involves the design of all the elements of the service system that are necessary to deliver the service, and all the elements of the service experience that are needed for the user to experience the service. Once the solution is developed (on paper), it needs to be validated before becoming a real service available on the market (Foglieni, Villari and Maffei, 2018). Therefore, service prototyping should take place in order to bring the new service ideas to life and test their value to the customers and relevant stakeholders.

Reflection consists on prototyping the service experience, which involves, in an iterative way, testing, improving and retesting the role of people, process and physical evidence. Prototyping allows customers and stakeholders to fully understand how intangible services will look and work. Generating such vision of the service concept in the mind of customers is the task at this stage. Moreover, prototyping provides feedback about the customers' perceptions of the service, empowering the capacity to develop ideas for a new service or develop improvements to an existing service (Patrício and Fisk, 2013; Stickdorn *et al.*, 2011). When it comes to test physical products, prototypes are build based on the previously visualised ideas and then tested them with customers or experts to gain feedback and consequently improve the prototypes and retest them until they match their expectations. Similarly, service design shares the same iterative approach of testing and retesting. However, prototyping intangible services requires distinctive methods from those implemented in product design prototyping (Stickdorn *et al.*, 2011).

Lastly, implementation refers to the activity of operationalize the new service concept and offer it to customers based on a consistent service concept formulated and tested during the previous stages (Patrício and Fisk, 2013; Stickdorn *et al.*, 2011). Implementation is a very delicate phase since it requires introducing changes within the organization concerning processes, people, procedures, and technical systems (Foglieni, Villari and Maffei, 2018).

SD strongly focuses on ideation and exploration phases. Nevertheless, how service concepts are specified and implemented has rarely been analyzed in the literature (Blomkvist and Holmlid, 2012; Yu and Sangiorgi, 2014). In addition, there are many techniques and methods

for idea generation and service concept development. However, service specification, prototyping and implementation lack of methods which are more suited to these later stages (Lee, 2016; Blomkvist and Holmlid, 2011). These claims appear to be consistent with a recent study conducted by Lee (2016) with people working in service design field. It showed a breach between the conceptualization of the service and its implementation. Interviewees drew attention to the lack of effective methods to document the service concept. This results in service concepts being "lost in translation" that can lead to an implemented service significantly different from the one envisioned. Also, according to Foglieni, Villari and Maffei (2018), SD processes are described very shortly, and service design literature only superficially explores how they can be pragmatically conducted.

2.4 Framework Overview

From an exploration of the literature, it is presented next the outline of the adopted theoretical framework for this study. The theoretical framework is based on the central concepts and theories of innovation processes and service design in the context of technology start-ups presented before. The following table (Table 1) lists the identified processes with corresponding definitions and references to the literature.

Innovation Processes		***Definitions***	***References***
Invention	R&D	Scientific research and development.	(Rothwell, 1994) (Fortenberry, 2013)
	Idea generation and identification	Formulation of new product and service ideas.	(D du Preez and Louw, 2008) (Fortenberry, 2013)
	Screening and evaluation	Searching or scanning the internal and external environment.	(Liao and Welsch, 2008) (Tidd, Bessant and Pavitt, 2005)
	Business analysis	Assess business viability.	
Development	Prototype	Development of a prototype.	(Eisenmann, Ries and Dillard, 2011)
	Test	Test prototypes with potential customers.	(Paternoster *et al.*, 2014) (Moogk, 2012)
	Build	Development of the solution.	
	Pivot	Review or change assumptions.	
Implementation	Commercialization	Products enter the market and get feedback from customers.	
	Scale	Accelerate business	

	growth.	
Service Design Processes		***References***
Exploration	Understanding stakeholders experience.	(Holmlid and Evenson, 2008)
Ideation	Generation and development of new service concepts.	(Stickdorn and Schneider, 2010) (Patrício and Fisk, 2013)
Reflection	Prototyping and testing new service concepts with potential customers.	(Brown, 2008) (Foglieni, Villari and Maffei, 2018)
Implementation	Planning, implementing and reviewing new services.	(Steen, Manschot and de Koning, 2011)

Table 1 - Innovation and service design processes

2.5 Research Question and Objectives

The literature has identified and described different forms of innovation models to understand better how innovation activities are performed. However, there's a lack of consensus about a universal model for the process of innovation and even less for the specific case of technology start-ups. Nevertheless, defining a universal model may be a challenging task since every start-up has its unique business model and path. Additionally, these models aren't well suited for other types of projects with a high degree of uncertainty and complexity, which are the case of technology start-ups' innovative solutions. Although NPD activities are essential for the development of incremental technological innovations, the development of radical solutions needs further understanding. More research is necessary towards a more profound and well-founded understanding of product and service development process in a start-up situation. Moreover, according to Foglieni, Villari and Maffei (2018), service design processes are described very shortly, and service design literature only superficially explores how they can be pragmatically conducted.

Overall, how service design can be applied in the context of technology start-ups and leverage technology innovation to develop valuable solutions for their current and potential customers still needs further attention.

To explore this topic further, the following research questions were formulated:

How do technology start-ups create new service solutions?

How can service design be incorporated and contribute to the innovation processes of technology start-ups?

3 Research Methodology

This chapter presents the research methodology adopted in this project. It begins with a brief explanation of the research approach and method, followed by the research design and the considerations applied in choosing the most appropriate empirical method for the objectives of this study.

3.1 Research Approach

There are two basic approaches to research, namely, qualitative and quantitative. Qualitative approaches deal with the subjective assessment of attitudes, opinions, and behavior. Typically, the techniques of focus group interviews, projective techniques, and depth interviews are used (Kothari, 2004). A qualitative approach allows the researcher to gain a rich insight into the complexity of technology innovation processes, which might not be possible with a quantitative approach. Therefore, this study employs a qualitative approach, since the experience and insights of the people who are involved in innovative projects can be better understood through words and the meanings rather than through numbers or frequencies.

3.2 Research Method

Within a qualitative approach, a multiple case study research was considered the adequate to address de research questions. According to Leonard-Barton (1990, p.249),

> A case study is a history of a past or current phenomenon, drawn from multiple sources of evidence. It can include data from direct observation and systematic interviewing as well as from public and private archives.

In fact, the case study method is preferred when "how" or "why" questions are being pose. The aim of conducting case study research is to investigate a contemporary and complex social phenomenon in depth within a real-life context, over which the investigator has little or no control (Yin, 2009). That being said, the case study method is considered a suitable research method to achieve the aim of this study underlying the research questions, that is, to understand how technology start-ups' currently create new service solutions and how service design can contribute to enhance that process. Moreover, single and multiple case studies are two variants of the case study research method (Yin, 2009). Since the project is conducted in the context of real-life across several companies, a multiple case study was performed.

Conducting case research has its challenges: it is time consuming, it needs skilled interviewers and researchers need to be cautious when drawing generalizable conclusions from a limited set of cases and in ensuring rigorous research. Nevertheless, the results of case research can have a very high impact because it can lead to new and creative insights and development of new theory (Voss, Johnson and Godsell, 2016).

The purpose of this research is to elaborate upon existing theory thus refine and extend it – *theory elaboration/refinement* (Voss, Johnson and Godsell, 2016). In practice, the research aims to understand the emerging phenomenon better and to propose new insights and ideas since existing literature is unable to provide a satisfactory representation of the studied

phenomenon. In place of theory or hypothesis testing, the study is concerned with gather evidence for understanding the phenomenon of creating innovative solutions.

3.3 Research Design

This chapter presents the research design adopted in this project as it identifies the unit of analysis, describes how the data was collected, explains how the data was analyzed and informs how the research is reported on the following chapter.

3.3.1 Unit of Analysis (Case)

The case research method uses case studies as its basis. A case study is a unit of analysis in case research (Voss, Johnson and Godsell, 2016). Since the objective of this research is to understand technology start-ups' process of creating new service solutions and their challenges in practice, the unit of analysis is the company itself. Even though decisions are made by individuals in these companies, these individuals are presumed to represent their company's circumstances. According to Case Study Research, cases should be selected based on replication logic that is, cases that are expected to lead to similar results - a literal replication-, or cases that are expected to lead to contrasting results but for predictable reasons - a theoretical replication-, (Yin, 2009). However, a convenience sample was selected on availability but with the literal replication logic taken into consideration. That being said, the study uses empirical data from seven technology start-ups (Table 2) that had previous (although some of them limited) experience with service design.

Start-up	Core Business	Interviewee position	Location
A	Hardware + Software	Co-founder/CEO	Porto
B	Hardware + Software	Co-founder /CEO	Porto
C	Software	Co-founder	Braga
D	Hardware + Software	Co-founder	Porto
E	Software	CEO	Lisbon
F	Hardware + Software	Co-founder	Coimbra
G	Software	CEO	Coimbra

Table 2 – Case studies profiles

3.3.2 Data Collection

The primary method of data collecting was semi-structured, one-to-one interviews conducted with founders and/or CEO of each start-up. Overall, interviews are an essential source of case study evidence because most case studies are about human affairs, which would be reported and interpreted through the eyes of specific interviewers, and well-informed respondents. The interviews can provide important insights about certain phenomenon being studied and also provide prior history of the situation, thus helping to identify other relevant sources of evidence (Yin, 2009). The purpose of the interviews in the present study was to get an in-depth understanding of how technology start-ups typically work as in their innovation processes, what challenges they face, and if any best practices could be observed. The average

interview took 30 minutes, and they were conducted not only in presence but also over phone calls and Skype according to convenience and geographical constraints. An interview guide with general questions served as a guideline. However, the structure of the interviews was flexible so that discussions could go in new and interesting directions. The interview guide was divided thematically into four main parts. The first part interrogates information about the overall development process (in the beginning and now). The second part focused on the importance of customer-orientation perceived by each technology start-up according to each interviewee. The third part intent to explore the start-up's approach to innovation. Lastly, the fourth part intent to examine the familiarization with service design and processes performed related to the methodology.

A typical case study is performed through the use of multiple sources of evidence to increase the validity of the findings (Yin, 2009). Hence, a data triangulation approach was performed in the present study, by combining the interviews with information displayed on the web such as press releases, structured interviews, and media coverage. The purpose of the data triangulation was to obtain further insights into additional corroborating or contradicting evidence.

3.3.3 Data Analysis

According to (Yin, 2009), there are three general analytic strategies for conducting the case study analysis, namely, relying on theoretical propositions which helps to focus the attention on specific data; thinking about rival explanations which is related to the first strategy and developing case descriptions for organizing the case study which is used when there is the difficulty in making the first two strategies work. In the present study, the theoretical framework developed in Chapter 2 regarding the central ideas of the innovation theories laid the foundation of the data analysis strategy. The purpose of the theoretical framework is to guide the research as it provides a context and a frame for examining the data.

All interviews were recorded and transcribed for analysis. The transcripts were managed and analyzed using software for qualitative data analysis, which in this case was NVivo10. All transcribed interviews were carefully read and coded to gather evidence on innovation processes, practices, challenges and lessons learned. Coding is one of the fundamental approaches to qualitative data analysis. It is a deep reflective practice, which helps researchers to organize and categorize data thus setting the stage for further analysis. In essence, codes are labels that assign meaning to the data collected during the research (Miles, Huberman and Saldana, 2014).

The coding process incorporated a balanced approach of deductive coding based on the theoretical framework and inductive coding for code creation (Fereday and Muir-Cochrane, 2006). The deductive approach involves a template in the form of 'codes' from a 'codebook' that is developed before commencing an in-depth analysis of the data and is based on the research questions and theoretical framework. The purpose of the codebook is to organize and identify similar or related units of texts for subsequent interpretation and to search for confirming/disconfirming evidence of these interpretations. This approach has its advantages and disadvantages when compared with other analysis methods. Regarding the advantages, making the codebook and coding the text is relatively quick, reproducible, and easy to grasp for those skeptical of qualitative research. On the downside, there is the potential risk of

missing information, especially if the codebook is produced in a completely a priori manner and the analyst runs the danger of not looking beyond the codes (Crabtree and Miller, 1999). This is the reason why an inductive approach was also conducted for the creation of codes. The inductive approach refers to the codes emerged progressively during data collection. This way, the researcher, no matter how conceptually oriented may be, he will not be tempted to force-fit the data into preexisting codes (Miles, Huberman and Saldana, 2014). Therefore, the coding process started by using a pre-defined code list and was later expanded during the analysis to capture emerging categories and themes (Voss, Johnson and Godsell, 2016).

As a first step, the transcripts were quickly browsed as a whole to make notes about the first impressions on the data. After that, the transcripts were carefully read line by line and relevant pieces of information were coded into the broad categories of the codebook illustrating the innovation and service design processes. The advantage of using these broad categories is that large amounts of text can be coded rapidly and that coded segments are longer with broader context preserved, allowing the researchers to access more text for interpretation with a given search (Crabtree and Miller, 1999). Nonetheless, the analysis of the text at this stage was guided, but not confined, by the preliminary codes. During the coding of transcripts, inductive codes were assigned to segments of data observed in the text. In a high-level, categories were organized by three main themes regarding innovation processes, service design processes, and service design adoption (see example on table 4).

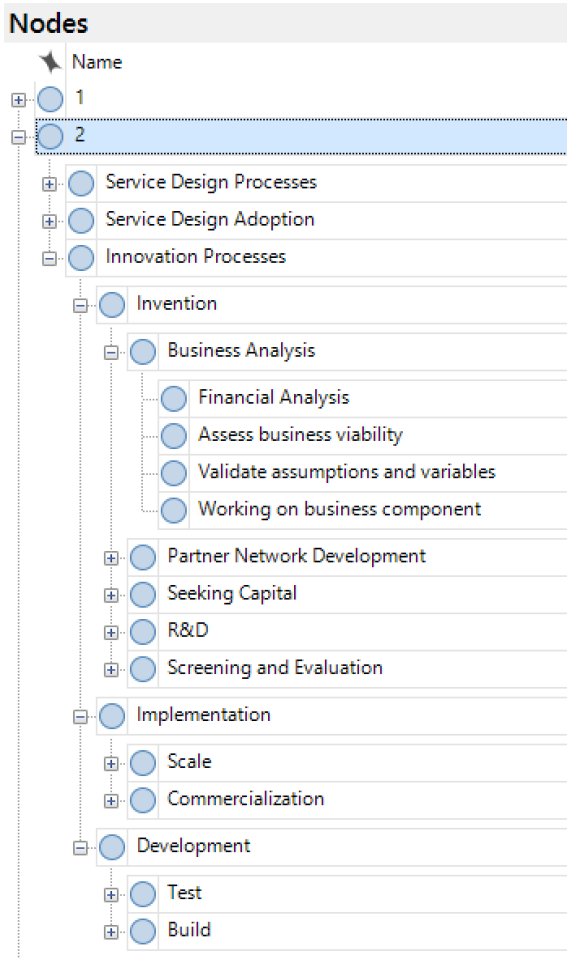

Figure 4 – Code Hierarchy Example

3.4 Reporting the Case Study

Multiple-case studies often contain both the individual case studies and one or more cross-case chapters (Yin, 2017). Regarding within-case analysis, the overall idea is to become intimately familiar with each case as a stand-alone entity, and to allow the unique patterns of each case to emerge before establishing generalizations across cases. This in turn gives the researcher significant insights can be drawn from each case, which might not be reflected in the cross-case analysis and the in-depth understanding that is needed for cross-case analysis. Moreover, the systematic search for cross-case patterns is a key step in case research. It is also essential for enhancing the generalizability of conclusions drawn from cases (Voss, Johnson and Godsell, 2016). The results are presented in two phases: 1) within-case analysis where every single case is presented in separated sections and 2) cross-case analysis.

4 Results and Findings

Based on the empirical findings, this chapter presents the empirical findings of the within-case and cross-case analysis of the seven cases studied.

4.1 Within-Case Analysis

This section presents the results of the within-case analysis where each case is reported in detail. The within-case analysis aims at describing, understanding and explaining what has happened in a single context or the "case" (Miles, Huberman and Saldana, 2014), which in the present research refers to each single technology start-up.

4.1.1 Case A

The idea for the business concept emerged from research and technology development. At that point, the founders decided to turn their research into business. One of the first main concerns was developing a minimum viable product. To validate the business idea, the founders met with potential customers and people who already had expertise in the matter. Regarding the technology itself, the only way to confirm its feasibility was to develop and test it. There has been no formal development process considering the size of the team, although it was made an effort to work in an agile way. The basics of business practices such as business model canvas, agile, lean and customer discovery were learned in acceleration programs, and every other opportunity to learn was taken. Taking into consideration it was the first time that the founders took such a project, the process was much based on discovery. Support like accelerators in early-stages was considered a critical factor, which had a massive influence on the overall start-up's performance. The learning process with an entrepreneur who was also involved in the creation of several start-ups made a significant difference on the mindset of the founders.

The founder considers essential to provide customers a prototype, so they can have a main idea of what the solution will look like and for them to test it. He considers that it is easier to get accurate feedback with a prototype rather than words or simple presentations. He also points outs that companies must look beyond what customers claim to be as their wants and needs; sometimes they do not know it. Translating B2B problems and needs is claiming to be different from B2C. When customers are businesses, numbers play a crucial role. Metrics are analyzed and are used to show customers problems they didn't know they have and how the solution can solve them. It is more of a qualitative perspective than qualitative - that's the exact opposite when it comes to B2C. However, the main difficulty for the founders was the access to customers, especially in B2B. He considers that approaching B2C is easier as one can even post questionnaires in social media and admits not having much expertise in approaching potential businesses customers. New ideas are generated internally but also with customer feedback. Typically, they present new ideas to customers and only after validation of the willing to pay for it, the development of new features and solutions starts.

The entrepreneur considers service design a useful methodology as it can help entrepreneurs to guide them through the process and assess the value of the business idea. Nevertheless, he

claims that it would be necessary to adapt service design guidelines and practices considering the nature and context of start-ups.

After reflection on the process so far, the founder thinks that the right way of creating new solutions is to find the problems first and then solve them with technology. However, he pointed out that it can also depend on the origin of the idea. Sometimes, the idea can arise from a market need, on other occasions, the idea emerges from the evolution of technology, so it makes sense to do research. Additionally, the founder now thinks that the first step shouldn't be getting funding but getting the customer. He said:

> *"We were thinking that just by participating in the workshops that we already knew what to do so we started to develop the product but maybe we had to stop and look again, study more about it and understand it better, how we really should be doing it... we must think about the market, about the business model and more important, what is the problem."*

Technology development is considered important but as important as that is also gain in-depth knowledge about the market and having contact with potential customers. This knowledge can have an impact while seeking funding because investors want to minimize the risk as much as possible. Typically, risk analysis has been left to the end of the process but should be done at the beginning. Every hypotheses and assumptions made about the business should be validated with the customers and the market.

4.1.2 Case B

The business idea begun with a final academic project. During the project, one of the first concerns was to assess if what was being developed had applicability and utility in the sector. To do that, a lot of companies were contacted to understand the problem in the real-life context. After the contact with the reality, the study was reframed and theories changed. After the conclusion of the academic project and the validation of hypotheses, the founder decided to move forward with the study and applied for a scholarship to form a start-up.

The development process was based on the previous knowledge attained in the university such as project management. In the beginning, the founder just had a numerical analysis and an idea on paper. A prototype had to be developed at the lab, and it was so rudimentary that had to be tested in the lab under a controlled environment. Only after validating the technological principles at the lab, the solution was ready to be tested on the reality. After validating on reality, the founders started to study the indicators and benefits to adjust the solution. Only a couple of years later they started to develop the business concept. Basically, it was an idea on paper, lab pilot, real-life pilot, testing, assumptions verifications and then work on the business component. The founder admitted that there wasn't room for activities like ideation; they couldn't get forward with the business concept without testing the technology itself, there was no point in doing PowerPoint presentations because since they were developing a radical innovation, they had to develop and test it first.

The biggest challenge pointed out was expectations 'management. Given the nature of the process, clients were contacted before the development of the technology in the lab. Customers looked forward to get the solution, but it took a lot of time to develop it. Since it

was the first time the founder took such a project, there were lots of things he didn't know and thus the process took more time in order to be possible to get more knowledge about the industry.

They developed the technology with potential customers since the beginning, and that was important because they could learn a lot about the market. They even would want to experience how was the daily-life of the end users. The founder claims that valuable feedback and insights come from living the daily life with them. Talking about his experience, he adds that one must go after the people who have the pains and the solution needs to be tested constantly. Nevertheless, the founder also says that it is important and necessary to create the vision in people's minds. Most of the times the team was able to identify the problem or need that the customer had but was not aware of it.

In the company, new ideas arise from daily life. The team constantly seeks other opportunities to scale by analyzing other realities and markets. The founder claims that it is important to constantly ask customers about their needs; otherwise the business will not move forward. In a start-up, the investments are insufficient thus resources are limited and focused on key activities.

The CEO claims that service design it is not an exact science. He thinks that SD is helpful, but it is not what makes the whole project work. He adds that SD is suitable for structuring thought and it can make the whole process more efficient.

During the academic project, the market research was focused on the technical side thus the emphasis was on looking for competitors or similar technological solutions. Since similar solutions were never found, the team decided to move forward. Later, they realized that looking for a similar solution was not about just having similar technology but also similar business, that is, another company that could solve the same problem differently or offer the same value. He argues:

> *"As far as I know, we were pioneers in doing this. We are the only ones solving the problem this way. This is one thing. Another thing is: from the business point of view, how is this problem solved? How is the problem solved in the market? That's something else, is it not? That's a different thing."*

Looking for something similar regarding technology was considered a mistake because it was only when they were in the business phase that they found people solving the same problem but with a different business. Besides, the founder claims that technology is very appealing, but the market works with numbers. Therefore, he thinks it is easier to get investors or partners interested in the business concept rather than the technology itself.

4.1.3 Case C

The idea emerged from a need identified in a real-life context. At the beginning, they had an initial debate of ideas, and many of the ideas were the base to the changes made on the platform. They made a list of ideas of improvement and then test them. This was considered a good way of work by the co-founder. The development of the business plan was done as a final academic project. In that project, several tools were used to test the business model. One of them was a questionnaire directed to the population in general to have a first impression of

what people would like and also to cover some metrics essential to assess the business viability. Besides, they also launched an early version of the platform, conducting a market test to determine the interest in the solution. At the start, they wanted to ensure that the service would work, so they decided to invest time in assuring the benefits of the solution.

The validation was based on assumptions and feedback they were getting from the market, and the evolution was always in that direction. After the first launch, they continuously released solutions to several platforms, but always with a simple version to test the market. Recently, they launched a new solution based on the feedback from previous releases, which has been successful. The founder states:

> *"This has been an evolution, and market testing is continuous, that is, it is never a permanent approach to the subject - it has been an ever-changing approach because the business model has been changed as we go forward, and the focus of the company has also been shifted."*

This process aims to reduce operating costs. If something goes wrong, they can rapidly take a step back. The biggest challenge is to show the value of the service. Customer feedback is the most crucial input, but typically, ideas are generated among the members of the team. They conduct weekly meetings to debate ideas and to discuss their roadmap and are always thinking about what they will do next.

Using service design tools in a fast and practical manner is considered the primary challenge, as it requires some adaptation and familiarization. The co-founder admits that all tools are welcome if they prove to be effective. The founder thinks that in a start-up entirely concentrated in technology and development of software, service design is essential and very useful. In those cases, it is vital to link customer opinions with the product in an embryonic phase. This is a problem that remains in many companies in Portugal, that is, the development of a product without taking into consideration customer wants and usability of the solution, thus service design is essential to tackle that issue.

4.1.4 Case D

Both the founders were studying in the same area and thought that it was an excellent opportunity to work together. Initially, they worked solely on technology because they felt that they would need to have a minimum viable product (prototype) so they could get funding. That being said. they spent a lot of time working on the prototype and features which the founder now considers a beginner mistake. A while after, they participated in an acceleration program that proved to be helpful as they focused on deconstructing the idea, thinking about the business and create the business concept. A first sketch of the business plan was done but acceleration programs do not include customer validation. After concluding the program, they went to the United Sates to talk to some of the largest institutions in this specific industry. They talked with potential clients and partners that, in turn, introduced them to other people. The founder mentioned that they managed to participate in several initiatives abroad and established very important business partnerships as they gave them the required industry-specific knowledge, and at the same time, feedback as customers. Besides, they also went to the biggest fair in the United States related to the industry to make the solution known and get more contacts. One big concern that most start-ups may not have is that they have contracts

signed with large corporations thus they are waiting for the product to be developed which put a lot of pression in the development process.

Like Steve Blank says in his methodology (Blank and Dorf, 2012), they pivot a lot according to feedback received. They would meet with potential customers and would present several proposals to receive feedback. The process was based on build-feedback. They did not have a structured process to generate new ideas; however, they adopted an iterative process. New ideas arise in the daily life, and every single feature that might be interesting was presented to customers and partners to have feedback and assure they were willing to pay for it before developing them.

The founder acknowledged that the reason they could move forward and were able to get funding was that customers signed letters stating they were willing to buy the solution. He considered that when the solution is not as something "cool" like an app, the business case must be solid. The founders did not know about management although the acceleration program significantly helped in that matter. One of the main difficulties felt was that the business was moving very quickly, and they still couldn't implement activities like quality management, control, etc.

Regarding the potential use of service design in technology-startups, the founder claims that each case is different; there is no fit for all service design models. Nevertheless, it could be interesting having good practices and guidelines. Something that could also be divided by modules, for example, guidelines for business based on apps, business based on hardware because they are very different realities. Looking back, the founder said that the best thing that happened was the participation in the acceleration program because it allowed focussing more on the business side. After that, they restarted the technology development. He considered that this way of doing saved time and money. He advocated Steve Blank's methodology and claims:

> *"The main step is to seek the problems. There is not a secret sauce; there is not a single way to do it, there is no right way. It is an iterative process, and we must constantly be with clients."*

It was also pointed out that the team should have an open mind to change thus the team makes a huge difference in the start-up’s success.

4.1.5 Case E

The idea emerged from the need to solve a problem which was felt by the founder. The business concept validation was much based on personal experience and the knowledge about its context. However, the founder considered that ideas and assumptions should always be validated, especially at the beginning; otherwise, the risk of creating a solution that does not meet customers' needs can be very high. The process of developing the product was very amateur although academic knowledge was naturally useful regarding the development of the technology. Since it was the first time that he created something from scratch, he confessed losing a lot of time on details and doing sketches, also on thinking how things would look like because he didn't have much experience with the process of product development. The process was very heuristic, based on trial and error thus it was based mostly on

experimentation and direct contact with customers. So, he started to develop the first version of the product and iterated as he presented several first versions to B2B customers.

He talked directly with customers ask them about their needs and wants and started to identify patterns. Some customers would want specific features, but it was important to prioritize them. At least, in an early-stage, the goal was to answer customer needs transversely. Regarding B2C customers, they were also getting feedback and suggestions, and they were iterating according to them.

Naturally, new ideas emerged on a daily basis, but they also had a systematic way of gathering insights into new ideas much based on metrics from the B2C side. They continually listened to their customers and it was considered essential to have some tools that allowed the gathering of that feedback in a systematical way to turn in into improvements. They also used some tools specifically for user experience and other "old-school" methods like interviews.

The founder considered that applying service design practices was very interesting. He adds:

> *"I think [service design] is important for any company because companies that aren't customer centered and do not try to go after the customers' needs eventually end up being overtaken or fail."*

However, he also thought that it is not worth to improve touchpoints if they do not improve the business metrics. It is important to align service design and its tools with business metrics otherwise companies won't be encouraged to use them. Service design can be an abstract methodology, but each case is different. He considered that service design should be a fundamental competence of every company. In a newly established company, at least someone should be familiarized with service design. In a large corporation, everyone should be familiarized with methodologies like service design. The background of the founders, team, and dimension of the company is considered to influence the SD use.

4.1.6 Case F

At first, the idea was a project just 'for fun.' After some time, the trend behind the concept of the idea started to rise in the United States. With the combination of the initial product, experience, and previous work, the founders decided to turn it into a business. Then they participated in an acceleration program for start-ups, and during the program, they realized it would require a considerable investment to develop the idea for a B2C market. Meanwhile, B2B customers got to know their business and started to contact them, so they listened to them and decided to begin to sell the product to B2B customers. Actually, according to the co-founder, accelerators and investors usually suggest beginning by B2C customers. So, they turned the business into the industry that tends to be open to this kind of initiatives and sought investments in order to move forward with the project. Meanwhile, they started to sell at international fairs, and last year they changed the business model again. They did that a lot of times because being a start-up is doing precisely that.

In the beginning, the validation was mostly based on experimentation. Then, in the acceleration program, the founders learned about business model canvas, so they started to validate everything. The founder said that in the beginning, it was relatively easy to test around and ask people for problems since it was a solution based on software. When they changed the product to more hardware base, things started to get more complex, so they began

doing market research and participating in international fairs in several countries to assess how the industry was evolving there. It took a couple of years to study the market aiming at evaluate which was the best path to follow. To offer the best solution possible, it was necessary to look for every problem, validate the whole process so that they could make something that would meet the market needs. Innovation was much based on experimentation. In essence, they were always validating with customers, and being a recent concept and solution, they are still learning about the topic and the industry.

They maintain constant contact with clients, they ask them how things are going, they even visit the customers, and use the industry as a case study. When they see something that can be improved, they work on it to a next release. They also work with universities, so they can innovate and get fresh ideas. The first idea was from the founders, and the following new ideas came from the market and the industry. The idea is now the result of feedback, and they do not move forward without validation of customers and partners.

The founder considered that service design methods are very beneficial. They have their own guidelines for branding, but he knows that there's much more than that. He thinks that every company should use service design guidelines on the development of the product, but also on everything that is around it, even the distributors, how people should behave, the experience of the clients, etc. Any start-up deals with a lot of things, and it is easy to forget about this kind of details, but it is considered very important. Sometimes founders are so focused on their worlds that those things end up being left aside. The co-founder admits that huge companies in Portugal do not usually have service design practices. With that in mind, he thinks that acceleration programs are very good and every accelerator should include service design in their programs and even have someone from service design to teach it. He says:

> *"People should start to think of everything in an integrated way; service design is an integration of everything the company represents and the ultimate customer experience. A start-up is typically formed by young people, so it is easy to realize the value of this."*

He thinks that the ideal phase to incorporate service design is when the company is better positioned in the market and is looking for a new round of investments to expand. Again, for people who are just starting, accelerator should include service design to let people know that it is important and they will need it.

In early-stages, service design is very helpful for startups offering software solutions and should be put in place because; however, it is more difficult to incorporate SD practices in the developing hardware-based solutions because the process is different, and it takes more time because it requires more prototyping, more development, and more testing. Either way, it is considered very important.

4.1.7 Case G

The business derived from the willing to creating something on this specific industry with the support of an existing software company and other people interested. The first step was an idea discussion about the business and the target market. After that, it was conducted a discussion with potential customers and assessed the business viability and technology feasibility. Having technology and market concept proven, they moved forward to investment.

The start-up always works with proximity to customers. One main concern at this initial stage is to balance the work capacity with customer wants and feedback. It is necessary to prioritize the functionalities that guarantee added value for the customer experience apart from the financial return and what is possible to develop in due time. The priority is to identify features that they are able to develop to guarantee the use of the solution and later customer retention thus customers' feedback is very important. New ideas, so far, emerge naturally whether they are internal input from the team or external inputs from the interaction with customers and partners. The start-up does not have the capacity, knowledge or time to put in place other methodologies because there is no need just yet as the founder claims; they keep on going with the feedback of customers and what emerges from them, meeting this way the main requirements first. However, they are moving forward to more structured processes across the company because as the company grows, there will be the need of more guidance because it will be impossible to work on everything locally and immediately.

When it comes to the 'new generation of products,' the founder does not know how service design could help in an initial phase of technology demonstration. However, he realizes it should be done in some cases:

> *"When we are designing something and trying to enter the technology market, it is almost certain that we will face competition. It can be something radically different, but usually, the market already has similar products or, at least, a substitute. Therefore, it is important to realize early in the process what the potential customers will think and feel about the solution, what to do, how to prioritize development, how to differentiate themselves from other competitors, how to develop technology that will meet customer's needs. It may seem a little counterintuitive for many people because of time pressure and urgency of technology development, but it seems an interesting idea to explore."*

Service design can help, at least, to create the vision for the path to follow in an initial stage and to strengthen the business model. Typically, start-ups founders are very inclined to develop technology and customers' needs and want are not the focus. They usually think that the technology will change everything, but the founder says technology is just one element of the business. The founder considers that the main difficulty is to prove the methodology' value to people who believe that what matters is the development of the solution itself, but he thinks that it can definitely help. For example, when start-ups are looking for fundraising, it is the differentiation of the business compared to the competition that it is going to help sell the idea. Companies show how they are going to solve the problem with the technology, but they can also create a strong and more interesting story around it and present it to a potential investor. Besides, having structure processes convince other people that they are doing things right.

4.2 Cross-Case Analysis

This section reports the results of the second part of the analysis, the cross-case analysis. In this section, all cases presented in the previous one will be compared, contrasted and synthesized. The objective of this section is to go beyond the findings from each case and reveal some main insights about the innovation processes adopted by the start-ups under study and their challenges plus benefits. The advantage of doing this type of analysis is that enhances generalizability or transferability to other contexts, that is, identify processes and outcomes across many cases thus developing more sophisticated descriptions and more powerful explanations (Miles, Huberman and Saldana, 2014).

The categories and their definitions of the cross-case analysis displayed on the following tables (Table 3 and Table 4) are based on the theoretical framework presented on chapter 2 and the emerging concepts of the inductive coding approach. The qualitative study revealed another two sub-processes within the 'Invention' main process, namely, partner network development and seeking capital. These two sub-processes are not reflected on the models of innovation and technology process, but they were considered important steps by the case studies and very emphasized in the empirical findings. Apart from this, the qualitative study also revealed sub-processes within the three main process of service design performed by the case studies.

Technology Innovation Processes		***Definitions***	***Occurrences***	***Illustrative Quotes***
Invention	R&D	Scientific researching and developing new technologies, which are mostly radical innovations.	A, B	"In our case, we were doing research and developing a technology" (A)
	Idea Generation and Identification	Generate/envision/identify a new start-up idea.	A, C, D, E, F, G	"… it was discussed what areas, problems and markets the company could address" (G)
	Screening and Evaluation	Analyze potential markets where the solution can be useful, the start-up's positioning, trends and competition.	A, B, C, D, E, F, G	"… we always use the industry as a case study." (F)
	Business Analysis	Identification of concepts, variables, assumptions, and hypotheses underlying the foundations for the business model.	A, B, C, D, E, F	"…try to identify what are the variables which can have influence on the business" (B)
	Partner Network Development	Partnering with investors or potential	B, D, G	"[partners] have been providing us

Technology Innovation Processes		*Definitions*	*Occurrences*	*Illustrative Quotes*
		clients to gather feedback about the business and the solution.		with very valuable feedback" (D)
	Seeking Capital	Obtain all the necessary resources including capital to start and scaling the business idea.	A, B, D, E, F, G	"… then [after building MVP] we started to look for investment." (A)
Development	Prototype	Developing a minimum viable product (MVP) which will be tested by stakeholders, especially customers.	A, C, D, E, F	"We had to build a minimum viable product, something that could work." (A)
	Test	Testing MVPs or more advanced products with stakeholders, especially customers.	A, B, C, E, F, G	"[the development process] has been an evolution from the beginning and through ongoing testing" (C)
	Build	Developing the final product or develop a more complete and sophisticated version of the product.	A, B, C, D, E, F	"I was showing the first versions to the clients and it [the solution] was built from there." (E)
	Pivot	Changing the business model or solution hypotheses.	D, F	We pivot a lot… we would show clients a proposal and if they rejected it, we would change it" (D)
Implementation	Commercialization	Releasing product or service to the market.	A, B, C, D, E, F, G	"We just launched the new platform with better features…" (C)
	Scale	Accelerate growth of the business.	B, C, G	"…refine the product to be installed in any market, in any company…" (B)

Table 3 – Cross-case analysis on technology innovation processes

SD Processes		*Definitions*	*Occurrences*	*Illustrative Quotes*
Exploration	Mapping and Reaching Stakeholders	Getting in touch with customers, experts and other stakeholders to collect insights and feedback.	A, B, C, D, E, F, G	"We went abroad to talk to hundreds of people which helped us validate our idea." (D)
	Gathering Contextual Information	Gathering existing information about the topic trough secondary research.	A, B, F	"… obviously we had to study the market and we have been always doing that." (F)
	Studying Users and Other Stakeholders	Observation of real-life experiences, behavior, and context; interviewing stakeholders	B, C, E	"… understand the problem and the reality I was studying to see if there was anything else I could solve." (B)
	Systematizing the Understanding of the Stakeholders	In-depth studying of customers' point of view.	A, B, E, G	"… customer journey is something that we do in the company and which is very important for us." (G)
Ideation	Generating New Service Solutions	Generating new service concepts whether for starting the business or for scaling.	A, B, C, E, G	"We have a weekly meeting with the entire team to debate ideas"; "… we make a list of ideas with potential improvements that can be made to the solution and then we test them." (C)
	Prioritizing Service Ideas	Prioritizing service ideas according to their viability.	G	"Clients input help us identify and prioritize the ideas that we can develop in due time and that ensures added value for the customer experience." (G)
Reflection	Prototype	Prototyping service concepts.	A, C, E	"We prepare demonstrations to show to clients in

SD Processes	*Definitions*	*Occurrences*	*Illustrative Quotes*
			order to assess their interest." (A)
Test	Testing service concepts with potential customers.	A, C, E	"There was a debate with potential users about a solution we were aiming to create in order to find the best fit." (E)

Table 4 - Cross-case analysis on SD processes

Early, low fidelity prototypes vs. high fidelity prototypes: In first place, it is important to notice that technology innovation and SD share the names of some of its processes, particularly prototyping and testing. While prototyping and testing regarding innovation processes refers to build and test MVPs or more advanced products with stakeholders, especially customers; prototyping and testing in SD represents the activity of prototyping and testing ideas with potential customers through the use of low to medium fidelity prototypes. The later SD approach was only reported by three cases (A, C and E). Case A considers the development of an early-prototype important because allows new potential customers to visualize how the product will work. Similarly, regarding Case C and E, the start-ups released a very simple version of the solution to get feedback of what potential customers would feel about it. On the contrary, the other cases developed more advanced products and iterated as customers give their feedback about it.

Partner network development and *seeking capital as specific activities of technology startups' innovation process:* The findings show that, in practice, technology start-ups perform innovation processes referred on the literature. It is important to point out, however, that two processes emerged from the findings that are not reported on the literature, namely, partner network development and seeking capital, as mention above. As noted in six cases, getting funding prove to be a major concern and it is closely related to other processes. In fact, Case D pointed out that the reason they could move forward and be able to get funding was that customers signed letters assuring they were willing to buy for the solution. So, before trying to get funding, they felt the need to develop a robust prototype to get customer validation. It is important to note that the participation on acceleration or incubation programs is not stated by almost models found on the literature, but the analysis pointed out that it is an important step for conceptualizing the business model component, even though the present research did not consider it as one of the processes. Nonetheless, acceleration programs seem to have a crucial and important role on the development of the start-ups.

Flexible sequencing of the overall process: The case studies showed that the interaction between their processes is very dynamic and very much depending on the steps and decisions made by the founders. It can take different directions but always focused on exploration. All cases were like the founder of case D said "there is not a single way to do it, there is no right way. It is an iterative process, and we must constantly be with clients". For example, Case C

states that a problem was understood in a real-life context, then after market analysis and customer validation, the team started to incrementally develop the solution. In contrast, Case B started with academic research, developing the technology and some years later started to conceptualize the business model. Additionally, much of the processes are partially conducted in parallel and influence each other serving as input. For instance, Case F claims to conduct an on-going market and industry analysis throughout the evolution of the business.

Flexible sequencing of the exploration phase: As stated by Case A, sometimes the business idea comes from the evolution of technology thus one can't help it but develop the solution as a first step. That was precisely what happened with start-up B as well. After the study of the theory and the observation of the reality, the technology had to go through feasibility demonstration first and maybe that is one of the reasons why ideation process is not report by the company in the early-stages, but it is later reported when thinking about scaling the business model. Therefore, some start-ups might not be able to perform the important phase of exploration in service design in early stages. There is indeed the high risk of developing solutions without understanding people and contexts but starting with development is the only way how some technologies are created, specially regarding radical innovations. However, this doesn't mean that understanding customers have no place in the process, but it can happen later, as what happened with company B.

Flexible sequencing of the ideation process: Empirical evidence also shows that four cases perform ideation (A, B, C and G). Case A and B reported to conduct ideation for new possible business solutions. Case C reported to conduct weekly meetings to generate and debate ideas. Case G performed ideation in the beginning of the overall process when assessing business possibilities. In fact, cases show that ideation does not take a specific place in the overall process. Instead, ideation is and can be used at the beginning, as an on-going task or when start-ups are ready to scale the business. From the analysis of the findings, technology start-ups also put their efforts in seeking feedback from customers with the aim of truly understand what it is that they want and need and in coming up with new ideas that meet and exceed their expectations.

The extent to which stakeholders are involved: Based on empirical findings and as one can see in Table 3, mapping and reaching stakeholders is reported by all cases which indicates the importance of getting the feedback of customers for them. Systematizing the Understanding of the Stakeholders is also mention by four start-ups. Results show that start-ups reach out to customers and reflect on their findings with the ultimate aim of validate their assumptions and solutions thus eliminating waste and reducing variation. However, SD encourages the exploration of possibilities and future opportunities, which makes it difficult to justify the advantages and outcomes of the creative process of service design to technology start-ups.

Lastly, it is worth pointing out that the reflection phase, mention by three start-ups, was performed in order to prototype envisioned ideas with the stakeholders and collect feedback on the service concepts, whether to add value to a developed solution (like Case A and C) or to explore possible business concepts at the beginning of the start-up creation process (like Case C and E). Implementation phase of the SD process was not mention at all by the interviewers and therefore, not included on the cross-case analysis.

SD Adoption		*Occurrences*	*Illustrative Quotes*
Benefits	Customer-centered	A, E, F	"I think it [Service Design] is important for any company because companies that do not focus on the client do not try to go after their needs end up eventually being outdated." (A)
	Increase Process Efficiency	A, B	"Talking to more potential customers right in the beginning of the project would have saved us a lot of time." (B) "The more contact you have with clients, the more efficient the process will be." (A)
	Risk Reduction	A	"The first thing to do should be the validation of all assumptions with the clients and the market to reduce the risk." (A)
	Fosters market fit	C	"[Service Design] It helps to match the customers' opinions with the product in early stages." (C)
	Promote business strength and differentiation	G, F	"[Service Design] it can boost brand recognition and lead to a better customer experience." (F)
Challenges	Difficult access to customers	A	"[Getting in touch with customers] It is our weakness and the most difficult thing to do." (A)
	Limited Resources	B, E, F, G	"Our resources are limited and very focused." (B)
	Lack of scientific proof	B	"[Service Design] it is not an exact science." (B)
	Requires adaptation	C	"The biggest challenge on using methodologies is to use them in a fast and effective way… it requires adaptation to make them work, that is what I personal feel." (C)
	Depends on business model	D, E	"Each case is different; there is no fit for all service design models." (D)
	Technology focus	F, G	"People that create start-us have a strong willingness to develop technology." (G)

Table 5 – Cross-case analysis on benefits and challenges of the adoption of service design processes

During the interviews, the respondents highlighting some perceived benefits and challenges related to using the practices of SD (Table 5). One of the most prominent challenges has been the lack of resources, specially time and capital. The highly competitive market, investment

rounds and requests coming from investors and other stakeholders put technology start-ups under a lot of pressure to develop solutions fast and release them to the market. The fast-paced work leads to cutting corners in other activities combined with a vision very focused on technology, did not leave room for Service Design practices. Also, the adaptation required to implement SD practices and the difficult access to customers might have hindered the possibility to test service concepts and observe the real-life context. Nevertheless, most of the companies pointed out that Service Design approach is it indeed very helpful. SD benefits on technology start-ups counterbalance the challenges as it can have a massive effect on the success of the business by accurately translate customers' needs and wants into products and services that enhance people's lives.

5 Discussion

The present research has focused on understanding innovation processes in technology start-ups as well as their challenges. Based on the empirical findings, the overall process performed by start-ups in the study does not seem to follow a specific model and depends mainly on the entrepreneur who makes the decisions. In most of the studied cases, the entrepreneurs do not have management knowledge but knows the business from scratch and makes decisions based on his expertise and available resources. This influence of factors such prior experience and knowledge on the innovation process was pointed also by some authors as well (Fagerberg and Mowery, 2009). The findings also corroborate the proposition that innovation processes do not necessarily follow a linear sequence from invention to implementation (Garud, Tuertscher and Van De Ven, 2013).

Regarding the hypothesis-driven entrepreneurship process, the model starts with the entrepreneur's vision of a problem and its potential solution (Eisenmann, Ries and Dillard, 2011). However, the model does not take into consideration all the steps taken before the business idea is set. In contrast, SD encourages as first steps the understanding of the problems, the contexts, the environments, and collecting insights about the users' needs (Brown, 2008; Patrício and Fisk, 2013; Steen, Manschot and De Koning, 2011). Nonetheless, in the field of technology start-ups, the process does not necessarily start by understanding and studying the problems and customers. In fact, all companies had different starting points from which they began to develop their offering, whether it was research, problem recognition in real-life context or even willing to develop innovative solutions. For instance, the founders of the company B did not have a clear vision from the beginning neither started by understanding the problem. The founders of the company B started by academic research complemented with market and industry analysis and after that they seek for customer validation. Only after a couple of years later, they began to formalize their business concept. Be that as it may, the important role of customers for the development process, especially in early stages, was strikingly pronounced in general. Interviews also show that a profound understanding of the customers can have a positive effect on start-ups performance.

It is worth to mention that software-based start-ups and hardware-based start-ups provide massively different solutions thus the innovation process differ a lot. In fact, regarding the specific case of hardware-based start-ups, they consider that hardware development process can take a while longer and is more complex because the technology feasibility needs to be tested. Especially in these cases, even though the need to understand customers does not seem to be new to the founders of startups, it is not a core part of their approach, which is very much focused on technology development and seeking investment.

In the case of the studied start-ups, five of them mentioned developing prototypes as the simpler versions of their solutions, and as they receive customer feedback, they released more complete versions. The common practice among these companies is the continuous improvement of the product based on market feedback and the network of contacts. This finding is in conformity with what literature stated before: the overall process is derived by feedback as different individuals interact with the innovation (Bosch *et al.*, 2013; Garud, Tuertscher and Van De Ven, 2013; Paternoster *et al.*, 2014). Nonetheless, Case B and G did

not mention prototyping activities but that might have to do with the fact of being radical innovations, so the feasibility of the technology must be proved first. In this case, the business concept was a concern only after some years of development. However, when this happens, typically there's the need for trying to fit in a market where it can be useful. In contrast, when the idea comes from the identification of a need in a specific sector or industry, the identification of the target market it is not questioned because it is an exploration of an opportunity in a given context.

Both technology innovation and SD approaches encourage the use of customer input. Both approaches embrace iteration and ongoing refinement using early prototyping for validating beliefs and assumptions, as well as eliciting reactions from all stakeholders. Even so, SD is performed by going forward and backward using low to medium fidelity prototypes such as cardboards and role-play (Stickdorn *et al.*, 2011). On the other hand, technology innovation is more like a development loop, where solutions take the form of high-fidelity prototypes (a simple first version of the technology) and are refined until it reaches the point where is fully developed. Commonly, when it comes to technology development, the learnings from the last iteration are the direct input for the next iteration and requirements are collected and prioritized before the development starts. Differently, in SD learnings are the base of an informed leap to something new. Given that, trial and error loop seems to be very common when technology start-ups are looking for its business model and testing the solution.

As pointed out by Case A, getting feedback from customers is harder in B2B contexts than B2C. Steve Blank advocates that one can "get out of the building" and talk to customers (Blank and Dorf, 2012). According to the founder of start-up A, that may work well when the target audience of the solution is the end consumer but when it comes to business as customers, the situation is very different. Some studied cases pointed out that in these situations, the common practice to assess the value of the solution for the customers is to analyse the business metrics and performance indicators. Entrepreneurs not only used them as a way to validate their solutions but also an instrument to make customers understand they have problems and how the solution could solve them. In B2B contexts, it is required specific expertise on studying customers problems which will entail more guidelines on how service design practices can be conducted.

As mention previously, SD encourages innovators to start by understanding customers, analyse the context and then generate possible service solutions. Based on the findings, it needs to be emphasized that even when a solution is in the development phase, new market insights and ideas do influence further actions, and in most high-technology organizations they are permanent activities. Market analysis generates ideas, and ideas can be explored while doing market analysis, so they are related to each other. In fact, many innovation and service design processes need to be conducted simultaneously. Market analysis is a continuous activity not just throughout the project to assure aiming in the right direction, but also for identifying future market opportunities, what is deeply entwined with ideation, the creative process of generating new ideas. Whether the new idea arises from an identified market need or technological possibility, it needs to be analyzed if technical feasibility or market acceptance respectively is given. Hence, the business component continues to be adapted, given new information and facts. Moreover, ideation, understanding, observation, market analysis and industry analysis is also important when it comes to mapping future

changes in business to expand it. The same logic can be applied to other processes such as prototyping and testing. New ideas are prototyped to be tested with customers, so start-ups can be sure they are developing solutions which meet their needs. This way, incremental developing takes place with these processes happening several times, mostly occurring at the same time.

Typically, most of innovation models do not consider establishing partnerships as one of the main processes. Most of them depict an idea as a starting point, and then prototyping and testing activities take place. Three cases mention the need to establishing partnerships that provided them with new insights and the required industry-specific knowledge and acts as a pilot customer at the same time. This way, partners can increase market acceptance and the success of the companies. Some entrepreneurs identified the proof of concept as the moment from which their idea generated credibility with investors and potential clients. In fact, one start-up mention that they only got funding because they brought signed letters from customers in united states assuring that they would buy the technology. Fundamentally, proof of concept with these institutions and business partners provides feedback for the business viability.

The relation between the use of SD and fundraising process is not yet well established. Nevertheless, one of the interviewees mentioned that, for example, when start-ups are looking for fundraising, it is the differentiation of the business compared to the competition that it is going to help sell the idea. They show how they are going to solve the problem with the technology, but they can also create a strong and more interesting story around it and to present to a potential investor (Case G). Therefore, SD might influence the process of fundraising. Nevertheless, it can be difficult to assess the actual value that Service Design will deliver to technology start-ups and even harder to estimate the return of an investment in service design processes and tools.

Although participation on acceleration or incubation programs is not stated by the models found on the literature, it was strikingly pronounced as an important milestone on the development of start-ups. Accelerators give structure to and shape the startup product development activities. That being said, there is a great potential to spread service design practices and guidelines by including them in their programs.

Companies might not be fully aware of being performing SD processes, but there is no doubt they are largely adopting them, particularly the first stages related to the exploration of ideas and the understanding of the customer point of view. Therefore, it is not necessary to implement service design practices from scratch, instead combine SD processes with innovation activities, since the ones already performed by the companies work pretty well. Moreover, encourage people to change completely the way they perform processes that prove to be effective might be counterproductive. A good solution would be to look at innovation processes and enhance them with service design practices to create solutions that fulfill and exceed the high expectations of customers. Since companies such as these are highly different and develop innovative solutions in a distinctive way, there is not a single and correct way to implement service design processes.

6 Conclusion and future research

The present research has aimed at exploring and understanding how can service design be incorporated in technology start-ups guided by the following research questions: How do technology start-ups create new service solutions? How can service design be incorporated and contribute to the innovation processes of technology start-ups?

To achieve this purpose, a theoretical framework (chapter 2) was described and seven case studies were conducted with technology start-up was interviewed. The work adopted a qualitative methodology making use of Case Study Research as the research method (chapter 3). The innovation processes performed by the companies were analyzed and discussed through within and cross-case analysis (chapter 4).

The empirical findings showed that start-ups use both innovation and SD processes. The interaction between the processes is very dynamic and very much depending on the steps and decisions made by the founders. It can take different directions but always focused on customer validation. Regarding the challenges of adopting practices of Service Design, it is worth to mention the limitation of resources. This lack of resources combined with a technology focus and adaptation required to implement service design are the main challenges mentioned by the founders. Nevertheless, most of the companies pointed out that Service Design approach is very helpful for start-ups meet customer needs.

By identifying the current processes on technology start-ups, the findings of the conducted multiple case study inform this practice and contribute to the lack of understanding on the matter. Although existing innovation process models do not entirely reflect the characteristics of innovation processes in technology start-ups, they serve as a useful basis to the research. The findings cannot be generalized to the entire industry; instead, they are meant to contribute to understand better how service design can be incorporated in technology start-ups innovation processes.

One of the significant limitations of this study was the difficulty in finding technology-based start-ups that would agree to participate in the study. Reasons such as lack of time, lack of resources or simple lack of interest are limitations that frustrate attempts to produce a meaningful sampling. However, it is believed that it has brought a sufficient diversity of situations in technology-based start-ups. Also, due to the characteristics of the matter in question, findings may not cover the entire pool of processes. As mention before, the overall process is a dynamic, continually changing process so founders may not recall every step and may miss something even though it was asked to talk about the process until the present moment.

Due to the limitations of this study and the limited prior research on the innovation processes in technology start-ups, more thorough investigation is needed to gain more profound understanding of this phenomenon. Most startups lack a process for discovering their markets, locating their first customers, validating their assumptions, and growing their business. Also, there is no recognized process with measurable milestones, for finding customers, developing the market, and validating the business model (Blank, 2003). One interesting research topic would naturally be the development of a new service design approach, that is adapted to the

specific characteristics and needs of technology start-up companies. It is also important to pointed out that situations involving radical solutions, hardware-based products and B2B customers require a special attention due to their complex nature. Nevertheless, defining a universal model may be a challenging task since every start-up has its unique business model and path. Moreover, another relevant topic would be to analyze which factors lead to a successful innovation by comparing technology innovation and service design processes underlying successful and unsuccessful innovations. The study pointed out some key challenges in adopting service design in technology-start-ups. It would be important to examine how start-ups can deal with the challenges to take advantage of the benefits.

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APPENDIX A: Interview Guide

1. Development process (in the beginning and now)
    a. How did you come up with the business idea?
    b. How did you make sure your assumptions were right? Did you do anything to validate the idea? Or did you just go for it?
    c. What product/service development process did you followed/follow?
    d. Can you see some advantages and challenges of how you are currently developing the service/product (way of working)?

2. Importance of customer-orientation
    a. In the process, are you incorporating market research? If so, how do you do it and why?
    b. What was / is your approach to trying to enter the market?
    c. Did you involve the customers in any phase of the process? If so, in which one?
    d. What are the challenges in trying to understand the needs of customers?

3. Innovation
    a. What made you decide to provide more services such as…? Where new ideas come from?
    b. How did you decide which aspects and functionality of the product or service to keep or abandon?
    c. If you wanted to innovate your service offering, what would you do to get new ideas?

4. Service Design
    a. Are you familiar with service design?
    b. Are there any tools or methods you know? I so, which are they?
    c. What do you think of the implementation of this approach in startups?